Estimating carbon dynamics in global aquifer systems using a mechanistic model

J.J. LANGEVELD[1]*, A.F. BOUWMAN[12], A.H.W. BEUSEN[12], W.J. VAN HOEK[1], J.J. MIDDELBURG[1]

[1] Department of Earth Sciences – Geochemistry, Faculty of Geosciences, Utrecht University, PO Box 80021, 3508 TA Utrecht, the Netherlands (*correspondence: j.j.langeveld@uu.nl)

[2] PBL Netherlands Environmental Assessment Agency, P.O Box 30314, 2500 GH Den Haag, the Netherlands

Global groundwater systems may play an important role in the processing and retention of carbon along the aquatic continuum. A spatially explicit model is developed to describe the carbon dynamics in groundwater systems at the global scale and give a first estimate of the role of groundwaters in the global carbon budget. Hydrology, lithology and the terrestrial carbon cycle in different biomes are used as conditions to describe dissolved organic carbon (DOC) and dissolved inorganic carbon (DIC) percolation from subsoils to aquifers and subsequently surface waters. The groundwater system consists of shallow and deep layers with a distribution of travel times. A first order decay rate depending on geohydrological and environmental conditions (i.e. residence time and temperature) is used to describe DOC processing and DIC production. Chemical weathering effecting DIC is also simulated. Both carbon species leave the groundwater system via riparian zones, hyporheic zones, by submarine groundwater discharge or groundwater withdrawal. The outline and main results of the model are presented as well as a a first estimation of the carbon budget of global aquifers. Our model will improve our understanding and allow to quantify the lateral transport of C in aquifers towards rivers and other surface waters in different biomes of the world.